

**WHAT IS CLAIMED IS:**

1 1. A method for controlling an engine having an intake manifold and an outlet control  
2 device coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 determining a driver torque command;

6 calculating a desired cylinder charge based on said driver torque command; and

7 adjusting the outlet control device to provide said desired cylinder charge.

1 2. The method recited in Claim 1 wherein said outlet control device is a valve of the engine  
cylinder with variable lift.

3. The method recited in Claim 1 wherein said outlet control device is a valve of the engine  
cylinder with variable timing.

4. The method recited in Claim 1 further comprising adjusting the inlet control device based on  
manifold pressure.

5. The method recited in Claim 4 wherein said manifold pressure is manifold absolute pressure.

1 6. The method recited in Claim 4 wherein said manifold pressure is manifold absolute pressure  
2 measured by a pressure sensor coupled to the intake manifold.

1 7. The method recited in Claim 4 wherein said adjusting the inlet control device further  
2 comprises adjusting the inlet control device based on manifold pressure and desired cylinder  
3 charge.

1 8. A method for controlling an engine having an intake manifold and at least one outlet control  
2 device coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 determining a driver torque command;

6 calculating a desired cylinder charge based on said driver torque command; and  
7 generating an outlet control device set-point and an inlet control device set-point based  
8 on said desired cylinder charge; and  
9 controlling the outlet control device to said outlet control device set-point and the inlet  
10 control device to said inlet control device set-point.

1 9. The method recited in Claim 1 wherein said outlet control device is a valve of the engine  
2 cylinder with at least one of variable lift or variable cam timing.

1 10. A method for controlling an engine having an intake manifold and at least one outlet control  
2 device coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 determining a driver torque command;  
6 calculating a desired cylinder charge based on said driver torque command; and  
7 adjusting the outlet control device so that actual cylinder charge approaches said desired  
8 cylinder charge.

1 11. The method recited in Claim 10 wherein said outlet control device is a valve of the engine  
2 cylinder with at least one of variable lift or variable timing.

1 12. The method recited in Claim 10 further comprising adjusting the inlet control device based  
2 on manifold pressure.

1 13. The method recited in Claim 12 wherein said manifold pressure is manifold absolute  
2 pressure measured by a pressure sensor coupled to the intake manifold.

1 14. The method recited in Claim 12 wherein said adjusting the inlet control device further  
2 comprises adjusting the inlet control device based on manifold pressure and desired cylinder  
3 charge.

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1 15. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:  
5       determining a driver torque command;  
6       calculating a desired cylinder charge based on said driver torque command; and  
7       generating an outlet control device set-point based on said desired cylinder charge and an  
8       indication of actual cylinder charge; generating an inlet control device set-point based on an  
9       engine operating parameter; and  
10       controlling the outlet control device based on said outlet control device set-point and the  
inlet control device based on said inlet control device set-point.

16. The method recited in Claim 15 wherein said outlet control device is a valve of the engine  
cylinder with at least one of variable lift or variable timing.

17. The method recited in Claim 15 wherein said engine operating parameter is manifold  
pressure.

18. The method recited in Claim 17 wherein said manifold pressure is manifold absolute  
pressure measured by a pressure sensor coupled to the intake manifold.

19. The method recited in Claim 16 wherein said generating said inlet control device set-point  
further comprises generating said inlet control device set-point based on manifold pressure and  
desired cylinder charge.

20. A method for controlling an engine having an intake manifold and an outlet control device  
coupled to the manifold for controlling flow exiting the manifold and entering at least one  
cylinder of the engine, the engine further having an inlet control device for controlling flow  
entering the manifold, the method comprising:  
      determining a driver torque command;  
      calculating a desired cylinder charge based on said driver torque command; adjusting the  
outlet control device based on said desired cylinder charge and an actual cylinder charge; and

adjusting the inlet control device based on an engine operating parameter.

21. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

determining a driver torque command;  
calculating a desired cylinder charge based on said driver torque command;  
adjusting the outlet control device based on said desired cylinder charge and an actual cylinder charge; and  
adjusting the inlet control device based on intake manifold pressure.

22. The method recited in Claim 21 wherein said intake manifold pressure is an absolute pressure.

23. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

determining a driver torque command;  
calculating a desired cylinder charge based on said driver torque command;  
adjusting the outlet control device to provide said desired cylinder charge; and  
adjusting the inlet control device based on intake manifold pressure.

24. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an electronically controlled throttle for controlling flow entering the manifold, the method comprising:

determining a driver torque command;  
calculating a desired cylinder charge based on said driver torque command;  
adjusting the outlet control device to provide said desired cylinder charge;

adjusting the electronically controlled throttle based on intake manifold-pressure; and  
controlling fuel injected into the engine based on a desired air-fuel ratio and actual airflow  
entering the cylinder.

25. A method for controlling an engine having an intake manifold and an outlet control  
device coupled to the manifold for controlling flow exiting the manifold and entering at least one  
cylinder of the engine, the engine further having an inlet control device for controlling flow  
entering the manifold, the method comprising:

determining a driver torque command;  
calculating a desired cylinder charge based on said driver torque command; and  
generating an outlet control device set-point based on said desired cylinder charge;  
generating an inlet control device set-point based on manifold pressure; and  
controlling the outlet control device based on said outlet control device set-point and the  
inlet control device based on said inlet control device set-point.

26. A method for controlling an engine having an intake manifold and at least one outlet  
control device coupled to the manifold for controlling flow exiting the manifold and entering at  
least one cylinder of the engine, the engine further having an inlet control device for controlling  
flow entering the manifold, the method comprising:

providing a command related to desired engine output;  
calculating a desired cylinder charge based on said command; and  
generating an outlet control device set-point based on said desired cylinder charge;  
generating an inlet control device set-point based on said desired cylinder charge and  
manifold pressure; and  
controlling the outlet control device based on said outlet control device set-point and the  
inlet control device based on said inlet control device set-point.

27. A method for controlling an engine having an intake manifold and an outlet control  
device coupled to the manifold for controlling flow exiting the manifold and entering at least one  
cylinder of the engine, the engine further having an electronically controlled throttle for  
controlling flow entering the manifold, the method comprising:

determining a driver torque command;



30. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

- determining a driver torque command;
- calculating a desired cylinder charge based on said driver torque command;
- measuring an airflow of the engine from a sensor; generating an outlet control device set-point based on said desired cylinder charge and said measured airflow;
- generating an inlet control device set-point based on manifold pressure; and
- controlling the outlet control device based on said outlet control device set-point and the inlet control device based on said inlet control device set-point.

31. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

- determining a torque command;
- calculating a desired cylinder charge based on said torque command;
- generating an outlet control device set-point based on said desired cylinder charge;
- generating an inlet control device set-point based on manifold pressure; and
- controlling the outlet control device based on said outlet control device set-point and the inlet control device based on said inlet control device set-point.

32. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

- determining a driver torque command;
- measuring airflow flowing through the engine;
- calculating a desired cylinder charge based on said driver torque command; adjusting the outlet control device based on said desired cylinder charge and said measured airflow; and
- adjusting the inlet control device based on manifold pressure.

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33. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:  
determining a driver torque command;  
calculating a desired cylinder charge based on said driver torque command; and  
generating an outlet control device set-point based on said desired cylinder charge and an actual cylinder charge; generating an inlet control device set-point based on manifold pressure; and controlling the outlet control device based on said outlet control device set-point and the inlet control device based on said inlet control device set-point.

34. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:  
determining a driver command;  
measuring airflow flowing through the engine;  
calculating a desired cylinder charge based on said driver command;  
adjusting the outlet control device based on said desired cylinder charge and said measured airflow; and  
adjusting the inlet control device based on manifold pressure.

35. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:  
determining a driver command;  
calculating a desired cylinder charge based on said driver command;  
adjusting the outlet control device based on said desired cylinder charge; and  
adjusting the inlet control device based on manifold pressure.



1 36. The method recited in Claim 35 wherein said desired cylinder charge is a desired cylinder  
2 air amount.

1 37. A method for controlling an engine having an intake manifold and an outlet control  
2 device coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 determining a driver command;

6 calculating a desired cylinder air amount based on said driver command;

7 adjusting the outlet control device to provide said desired cylinder air amount; and

8 adjusting the inlet control device based on manifold pressure.

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38. A method for controlling an engine having an intake manifold and an outlet control device  
coupled to the manifold for controlling flow exiting the manifold and entering at least one  
cylinder of the engine, the engine further having an inlet control device for controlling flow  
entering the manifold, the method comprising:

determining a desired engine output;

calculating a desired cylinder air amount based on said desired engine output;

adjusting the outlet control device to provide said desired cylinder air amount; and

adjusting the inlet control device based on manifold pressure.

1 39. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 determining a driver command;

6 calculating a desired cylinder air amount based on said driver command;

7 adjusting the outlet control device based on said desired cylinder air amount;

8 adjusting the inlet control device based on manifold pressure;

9 determining actual cylinder air amount based on manifold pressure; and

10 controlling fuel injected into the engine based on said actual cylinder air amount.

1 40. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 determining a driver command;  
6 calculating a desired cylinder air amount based on said driver command;  
7 adjusting the outlet control device based on said desired cylinder air amount;  
8 adjusting the inlet control device based on manifold pressure;  
9 determining actual cylinder air amount based on measured mass air flow; and  
10 controlling fuel injected into the engine based on said actual cylinder air amount.

1 41. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 determining a driver command;  
6 calculating a desired cylinder air amount based on said driver command;  
7 adjusting the outlet control device based on said desired cylinder air amount;  
8 adjusting the inlet control device based on manifold pressure;  
9 determining actual cylinder air amount based on measured manifold pressure; and  
10 controlling fuel injected into the engine based on said actual cylinder air amount.

1 42. The method recited in Claim 41 wherein said measured manifold pressure is a measured  
2 manifold absolute pressure.

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1 43. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the outlet control device being at least one of the intake or exhaust valves  
5 of the cylinder, the method comprising:

6 determining a desired engine output;  
7 calculating a desired cylinder charge based on said desired engine output;

8 adjusting valve lift or valve timing of the outlet control device to provide said desired  
9 cylinder charge; and  
10 adjusting the inlet control device based on an engine operating parameter.

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1 44. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the outlet control device being at least one of the intake or exhaust valves  
5 of the cylinder, the method comprising:

6 determining a desired engine output based on a desired engine speed and an actual engine  
7 speed;

8 calculating a desired cylinder charge based on said desired engine output;

9 adjusting valve lift or valve timing of the outlet control device to provide said desired  
10 cylinder charge; and

adjusting the inlet control device based on an engine operating parameter.

1 45. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the outlet control device being at least one of the intake or exhaust valves  
5 of the cylinder, the method comprising:

6 determining a desired engine output based on a desired engine speed and an actual engine  
7 speed; calculating a desired cylinder charge based on said desired engine output;

8 adjusting valve lift or valve timing of the outlet control device to provide said desired  
9 cylinder charge; and

10 adjusting the inlet control device based on manifold pressure.

1 46. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the outlet control device being at least one of the intake or exhaust valves  
5 of the cylinder, the method comprising:

6 determining a desired engine torque based on a desired engine speed and an actual engine  
7 speed;  
8 calculating a desired cylinder charge based on said desired engine torque;  
9 adjusting valve lift or valve timing of the outlet control device to provide said desired  
10 cylinder charge; and  
11 adjusting the inlet control device based on manifold pressure.

1 47. A method for controlling an engine having an intake manifold and at least one outlet control  
2 device coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

5 providing a command related to desired engine output;  
6 controlling the inlet control device in response to at least an indication of intake manifold  
7 pressure; and  
8 controlling the outlet control device while said inlet control device is being controlled to  
9 adjust engine output toward said desired engine output.

1 48. A method for controlling an engine having an intake manifold and at least one outlet control  
2 device coupled to the manifold for controlling at least a portion of flow exiting the manifold and  
3 entering at least one cylinder of the engine, the engine further having an inlet control device for  
4 controlling flow entering the manifold, the method comprising:

5 providing a command related to desired engine output;  
6 controlling the outlet control device in response to at least said command to adjust engine  
7 output toward said desired engine output; and  
8 controlling the inlet control device in response to at least an indication of intake manifold  
9 pressure to reduce an effect of said outlet control device control on said manifold pressure.

1 49 The method recited in claim 48 comprising a plurality of outlet control devices each one  
2 coupled to a respective engine cylinder and wherein said controlling of the outlet control devices  
3 controls each of the outlet control devices.

1 50. The method recited in claim 49 wherein each of the outlet control devices comprises at  
2 least one of an inlet or an exhaust valve and wherein said controlling of the outlet control devices  
3 controls valve timing or valve lift.

1 51. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

- 5 determining a desired engine output;
- 6 calculating a desired cylinder charge based on said desired engine output;
- 7 adjusting the outlet control device to provide said desired cylinder charge; and
- 8 adjusting the inlet control device based on intake manifold pressure.

1 52. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an inlet control device for controlling flow  
4 entering the manifold, the method comprising:

- 5 determining a desired engine output;
- 6 calculating a desired air amount based on said desired engine output;
- 7 adjusting the outlet control device to provide said desired air amount; and
- 8 while adjusting the outlet control device, adjusting the inlet control device based at least  
9 on intake manifold pressure.

1 53. A method for controlling an engine having an intake manifold and an outlet control device  
2 coupled to the manifold for controlling flow exiting the manifold and entering at least one  
3 cylinder of the engine, the engine further having an electronically controlled throttle for  
4 controlling flow entering the manifold, the method comprising:

- 5 determining a desired engine output;
- 6 calculating a desired cylinder charge based on said desired engine output;
- 7 adjusting the outlet control device to provide said desired cylinder charge;
- 8 adjusting the electronically controlled throttle based on intake manifold pressure; and

controlling fuel injected into the engine based on a desired air-fuel ratio and an indication of actual airflow entering the cylinder.

54. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

- determining a desired engine output;
- calculating a desired cylinder charge based on said desired engine output; and
- generating an outlet control device set-point based on said desired cylinder charge;
- generating an inlet control device set-point based on manifold pressure; and
- controlling the outlet control device based on said outlet control device set-point and the inlet control device based on said inlet control device set-point.

55. A method for controlling an engine having an intake manifold and an outlet control device coupled to the manifold for controlling flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an electronically controlled throttle for controlling flow entering the manifold, the method comprising:

- determining a desired engine output;
- calculating a desired cylinder charge based on said desired engine output;
- generating an outlet control device set-point based on said desired cylinder charge;
- generating a target throttle position based at least on manifold pressure; and
- controlling the outlet control device based on said outlet control device set-point and the electronically controlled throttle based on said target throttle position.

56. A method for controlling an engine having an intake manifold and at least one outlet control device coupled to the manifold for controlling at least a portion of flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

- providing a command related to desired engine output torque;
- controlling the outlet control device in response to at least said command to adjust engine output toward said desired engine output; and

controlling the inlet control device in response to at least an indication of intake manifold pressure to reduce an effect of said outlet control device control on said manifold pressure.

57. A method for controlling an engine having an intake manifold and at least one outlet control device coupled to the manifold for controlling at least a portion of flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the method comprising:

providing a command related to desired engine output;  
controlling the outlet control device in response to at least said command to adjust engine output toward said desired engine output, the outlet control device being either an intake or exhaust valve of the cylinder; and

controlling the inlet control device in response to at least an indication of intake manifold pressure to reduce an effect of said outlet control device control on said manifold pressure.

58. A method for controlling an engine having an intake manifold and at least one outlet control device coupled to the manifold for controlling at least a portion of flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an inlet control device for controlling flow entering the manifold, the outlet control device being either an intake or exhaust valve of the cylinder the method comprising:

providing a command related to desired engine output;  
controlling either valve lift or valve timing of the outlet control device in response to at least said command to adjust engine output toward said desired engine output; and  
controlling the inlet control device in response to at least an indication of intake manifold pressure to reduce an effect of said outlet control device control on said manifold pressure.

59. A method for controlling an engine having an intake manifold and at least one outlet control device coupled to the manifold for controlling at least a portion of flow exiting the manifold and entering at least one cylinder of the engine, the engine further having an electronically controlled throttle for controlling flow entering the manifold, the outlet control device being either an intake or exhaust valve of the cylinder the method comprising:

providing a command related to desired engine output;

7 controlling either valve lift or valve timing of the outlet control device in response to at  
8 least said command to adjust engine output toward said desired engine output; and

9 controlling position of the electronically controlled throttle in response to at least an  
10 indication of intake manifold pressure to reduce an effect of said outlet control device control on  
11 said manifold pressure.

1 60. A method for controlling an engine having an intake manifold and at least one outlet control  
2 device coupled to the manifold for controlling at least a portion of flow exiting the manifold and  
3 entering at least one cylinder of the engine, the engine further having an electronically controlled  
4 throttle for controlling flow entering the manifold, the outlet control device being either an intake  
5 or exhaust valve of the cylinder the method comprising:

6 providing a command related to desired engine output;  
7 controlling either valve lift or valve timing of the outlet control device in response to at  
8 least said command to adjust engine output toward said desired engine output; and  
9 controlling position of the electronically controlled throttle in response to at least an  
10 indication of intake manifold pressure to reduce an effect of said outlet control device control on  
11 said manifold pressure and thereby maintain said manifold pressure at a relatively constant value.

1 61. A method for controlling an engine having an intake manifold and at least one outlet control  
2 device coupled to the manifold for controlling at least a portion of flow exiting the manifold and  
3 entering at least one cylinder of the engine, the engine further having an electronically controlled  
4 throttle for controlling flow entering the manifold, the outlet control device being either an intake  
5 or exhaust valve of the cylinder the method comprising:

6 providing a command related to desired engine output torque;  
7 controlling either valve lift or valve timing of the outlet control device in response to at  
8 least said command to adjust engine output torque toward said desired engine output torque; and  
9 controlling position of the electronically controlled throttle in response to at least an  
10 indication of intake manifold pressure to reduce an effect of said outlet control device control on  
11 said manifold pressure and thereby maintain said manifold pressure at a relatively constant value.

1 62. A method for controlling an engine having an intake manifold and at least one outlet control  
2 device coupled to the manifold for controlling at least a portion of flow exiting the manifold and



entering at least one cylinder of the engine, the engine further having an electronically controlled throttle for controlling flow entering the manifold, the outlet control device being either an intake or exhaust valve of the cylinder the method comprising:

providing a command related to desired engine output torque;

determining a desired cylinder air charge based on said desired output torque controlling either valve lift or valve timing of the outlet control device in response to at least said command and said desired cylinder air charge to adjust engine output torque toward said desired engine output torque; and

controlling position of the electronically controlled throttle in response to at least an indication of intake manifold pressure to reduce an effect of said outlet control device control on said manifold pressure and thereby maintain said manifold pressure at a relatively constant value.

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